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(54) ETCHING SOLUTION, ETCHED ARTICLE AND METHOD FOR ETCHED ARTICLE

(57) An etching solution which contains hydrogen fluoride (HF) and exhibits an etching rate ratio: etching rate for a boron-glass film (BSG) or boron-phosphorus-glass (BPSG)/etching rate for a thermally oxidized film (THOX) of 10 or more at 25°C.

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Description

TECHNICAL FIELD

[0001] The present invention relates to an etching solution, a method for producing an etched article and an etched article produced by the method, more specifically, an etching solution and a method for producing an etched article for selectively etching a doped oxide film, particularly BSG or BPSG relative to an undoped oxide film, particularly THOX, and an etched article produced by the method.

BACKGROUND ART

[0002] Conventionally, as etchants for silicon wafers and the like have been used buffered hydrofluoric acids comprising HF (50% by weight) and NH_4F (40% by weight) at such a ratio that can achieve a desired etch rate.

[0003] However, the buffered hydrofluoric acids etch not only doped oxide films such as BSG films, BPSG films, phosphosilicate glass (PSG) films, arsenic silicate glass (AsSG) films and the like, but also undoped oxide films such as USG including TEOS (oxide obtained by CVD method using tetraethoxysilane gas) films, THOX and the like. Therefore, the buffered hydrofluoric acids can not selectively etch the doped oxide films.

[0004] An object of the present invention is to provide an etching solution and an etching method for selectively etching oxide films doped with impurities relative to TEOS and THOX.

DISCLOSURE OF INVENTION

[0005] The present invention relates to the items 1-16 listed below.

Item 1: An etching solution comprising hydrofluoric acid, wherein an a ratio of etch rate of a boron silicate glass film (BSG) or boron phosphosilicate glass / an etch rate of a thermal oxide film (THOX) at 25°C is 10 or higher.
Item 2: The etching solution according to item 1, wherein a solvent in the etching solution has a relative dielectric constant of 61 or lower.
Item 3: The etching solution according to item 1, the solution containing at least one member selected from the group consisting of an organic acid and an organic solvent having a hetero atom.
Item 4: The etching solution according to item 1, the solution containing (i) water and (ii) at least one member selected from the group consisting of an organic acid and an organic solvent having a hetero atom, the water being contained in a concentration of 70% by weight or lower.
Item 5: The etching solution according to item 1, wherein the weight ratio of HF : isopropyl alcohol : water is 0.1-50% by weight : 30-99% by weight : 0-70% by weight.
Item 6: The etching solution according to item 1, wherein the weight ratio of HF : acetic acid : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.
Item 7: The etching solution according to item 1, wherein the weight ratio of HF : tetrahydrofuran : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.
Item 8: The etching solution according to item 1, wherein the weight ratio of HF : acetone : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.
Item 9: The etching solution according to item 1, wherein the weight ratio of HF : methanol : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.
Item 10: The etching solution according to item 1, wherein the weight ratio of HF : ethanol : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.
Item 11: The etching solution according to item 1, the solution comprising an inorganic acid.
Item: 12 The etching solution according to item 11, wherein the inorganic acid has a pKa value at 25°C of 2 or lower.
Item 13: The etching solution according to item 11, wherein the weight ratio of HF : HCl : water is 0.01-50% by weight : 1-36% by weight : 0-99% by weight.
Item 14: The etching solution according to item 11, wherein the weight ratio of HF : HNO_3 : water is 0.01-50% by weight : 1-70% by weight : 0-99% by weight.
Item 15: A method for producing an etched article by etching an article to be etched with the etching solution as defined in any of items 1-14.
Item 16: An etched article which is obtainable by the method of item 15.

[0006] According to the etching solution of the invention, the ratio of BSG etch rate / THOX etch rate and/or the ratio of BPSG etch rate / THOX etch rate at 25°C is/are 10 or higher, preferably 20 or higher, more preferably 50 or higher, particularly 100 or higher.

[0007] In case of using TEOS instead of THOX, the ratio of BSG etch rate / TEOS etch rate and/or the ratio of BPSG etch rate / TEOS etch rate at 25°C is/are 5 or higher, preferably 10 or higher, more preferably 50 or higher, particularly 100 or higher.

[0008] The etch rate of the etching solution of the invention can be calculated as the difference in thickness of a film (BSG; BPSG; THOX; TEOS and like USG, etc.) before and after etching divided by etch time.

[0009] The water content is not higher than 70% by weight, preferably not higher than 30% by weight, more preferably about 30-5% by weight. The relative dielectric constant of the etching solution expresses an arithmetic mean of the relative dielectric constants of the components of the etching solutions other than the HF and inorganic acid.

[0010] Preferable examples of the inorganic acid include inorganic acids having a pKa value at 25°C of 2 or lower, for example, hydrochloric acid (pKa =-8), nitric acid (pKa=-1.8), hydrobromic acid (pKa=-9), hydroiodic acid (pKa=-10) and perchloric acid (a pKa-unmeasurably strong acid).

[0011] Examples of the organic acid include acetic acid (relative dielectric constant: 6.15 (20°C)), propionic acid (relative dielectric constant: 3.4 (40°C)), butyric acid (relative dielectric constant: 2.97(20°C)), isobutyric acid (relative dielectric constant: 2.73(40°C)), valeric acid, caproic acid (relative dielectric constant: 2.63(71°C)), caprylic acid (relative dielectric constant: 2.45(20°C)), monochloroacetic acid (relative dielectric constant: 21 (20°C)), dichloroacetic acid (relative dielectric constant: 8.08(20°C)), trichloroacetic acid (relative dielectric constant: 4.6 (60°C)), monofluoroacetic acid, difluoroacetic acid, trifluoroacetic acid, α-chlorobutyric acid, β-chlorobutyric acid, γ-chlorobutyric acid, lactic acid (relative dielectric constant: 22(70°C)), glycolic acid, pyruvic acid, glyoxalic acid, acrylic acid and like monocarboxylic acids, methanesulfonic acid, toluenesulfonic acid and like sulfonic acids, oxalic acid, succinic acid, adipic acid, tartaric acid, citric acid and like polycarboxylic acids.

[0012] Examples of the organic solvent having a hetero atom include methanol (relative dielectric constant: 32.6 (25°C)), ethanol (relative dielectric constant: 24.6 (25°C)), isopropanol (IPA, relative dielectric constant: 19.9 (25°C)), 1-propanol (relative dielectric constant: 22.2 (25°C)), 1-butanol (relative dielectric constant: 17.1 (25°C)), 2-butanol (relative dielectric constant: 15.5 (19°C)), t-butanol (relative dielectric constant: 11.4 (19°C)), 2-methyl-1-propanol (relative dielectric constant: 17.95 (20°C)), 1-pentanol (relative dielectric constant: 13.9 (25°C)), 1-hexanol (relative dielectric constant: 13.3 (25°C)), 1-heptanol, 4-heptanol, 1-octanol (relative dielectric constant: 10.34 (20°C)), 1-nonylalcohol, 1-decanol, 1-dodecanol and like alcohols; ethylene glycol (relative dielectric constant: 37.7 (20°C)), 1,2-propanediol (relative dielectric constant: 32.0 (20°C)), 2,3-butanediol, glycerin (relative dielectric constant: 42.5 (25°C)) and like polyols, acetone (relative dielectric constant: 20.7 (25°C)), acetylacetone, methyl ethyl ketone (relative dielectric constant: 18.51 (20°C)) and like ketones; acetonitrile (relative dielectric constant: 37.5 (20°C)), propionitrile (relative dielectric constant: 29.7 (20°C)), butyronitrile (relative dielectric constant: 20.3 (20°C)), isobutyronitrile (relative dielectric constant: 20.4 (20°C)), benzonitrile (relative dielectric constant: 25.2 (25°C)) and like nitriles; formaldehyde, acetaldehyde, propionaldehyde and like aldehydes; ethylene glycol monomethyl ether, ethylene glycol monoethyl ether and like alkylene glycol mono alkyl ethers; tetrahydrofuran (relative dielectric constant: 7.6 (25°C)), dioxane (relative dielectric constant: 2.2 (25°C)) and like ethers, trifluoroethanol, pentafluoropropanol, 2,2,3,3-tetrafluoro propanol and like fluorine alcohols, sulfolane (relative dielectric constant: 43.3 (20°C)), nitromethane (relative dielectric constant: 35.87 (30°C)) and the like.

[0013] The relative dielectric constant of water is 78.3 (25°C).

[0014] The content of HF is about 0.01-50% by weight, preferably about 1-5% by weight.

[0015] The water content is not higher than 70% by weight, preferably not higher than 30% by weight, more preferably about 0-5% by weight.

[0016] The content of the inorganic acid is about 1-99% by weight, preferably about 30-70% by weight.

[0017] The content of the organic acid is about 30-99.9% by weight, preferably about 70-99.9% by weight.

[0018] The content of the organic solvent having a hetero atom is about 30-99.9% by weight, preferably about 70-99.9% by weight.

[0019] The content of at least one member selected from the group consisting of the inorganic acid, organic acid and organic solvent having a hetero atom is about 30-99.9% by weight, preferably about 70-99.9% by weight.

[0020] The inorganic acid has a pKa at 25°C of about 2 or lower, preferably about -5 or lower.

[0021] The relative dielectric constant of the organic acid and organic solvent having an hetero atom is preferably about 40 or lower, more preferably about 10 or lower.

[0022] As the HF is usually used dilute hydrofluoric acid (50 wt. % aqueous solution). However, when the HF does not contain water, 100% HF may be also used.

[0023] In case of HCl, HBr and HI, an anhydrous etching solution can be prepared by blowing these gases through the etching solution.

[0024] Preferable etching solutions of the present invention and their compositions are shown below.

- HF: IPA : water = 1-10% by weight : 70-99% by weight : 0-30% by weight
- HF: acetic acid : water = 0.5-5% by weight : 70-99.5% by weight : 0-30% by weight

- HF : HCl : water = 0.01-5% by weight : 1-36% by weight : 50-99% by weight
- HF : nitric acid : water = 0.01-5% by weight : 1-70% by weight : 20-99% by weight
- HF: acetone : water = 1-10% by weight : 70-99% by weight : 0-30% by weight
- HF: THF : water = 1-10% by weight : 70-99% by weight : 0-30% by weight
- HF: methanol : water = 1-10% by weight : 70-99% by weight : 0-30% by weight
- HF: ethanol : water = 1-10% by weight : 70-99% by weight : 0-30% by weight

[0025] The etching solution of the invention can be suitably used for selectively etching a doped oxide film of an article to be etched comprising an oxide film (BSG, BPSG, etc.) doped with B, P and the like and an undoped oxide film such as THOX, TEOS and like.

[0026] In the etching method of the present invention, the temperature of the etching solution is about 15-40°C.

[0027] Examples of the article to be etched include single crystalline silicon wafers, gallium-arsenic wafers and like wafers, especially the articles comprising a doped oxide film (BSG, BPSG, etc.) and an undoped oxide film (THOX, TEOS and like USGs).

[0028] The BSG etch rate of the etching solution of the invention is usually about 10-2000 nm/min, preferably about 40-500 nm/min.

[0029] The present invention can provide an etching solution which can selectively etch films doped with impurities, such as BSG, BPSG and the like, relative to THOX, TEOS and like USG, a method for producing an etched article using the etching solution and an etched article.

BEST MODE FOR CARRYING OUT THE INVENTION

[0030] The present invention will be explained in more detail with referring to Examples and Comparative Examples below.

Examples 1-2 and Comparative Examples 1-4 (inorganic acid)

[0031] Etching solutions were prepared by mixing HF, water, an organic solvent having a hetero atom (isopropyl alcohol (IPA), THF, acetone, methanol, ethanol), an organic acid (acetic acid) and inorganic acid (HCl, HNO_3) in the ratios shown in Table 1. Test substrates were produced by forming each of a thermal oxide (THOX) film, USG (TEOS) film, boron silicate glass (BSG) film and boron phosphosilicate glass (BPSG) film on a silicon substrate by CVD method using a tetraethoxysilane gas. The etch rate and etch selectivity of the etching solutions on the test substrates were determined.

[0032] In addition, the etch rate and selectivity of conventional HF-H_2O and HF-NH_4F-H_2O etching solutions were determined in the above-mentioned manner as Comparative Examples.

[0033] The etch rate was determined by measuring the thickness of the films before and after etching with an Auto EL-III ellipsometer manufactured by Rudolf Research.

[0034] The etch rates of the etching solutions were calculated as the difference in thickness of films before and after being etched at 25°C divided by etch time.

[0035] The results of the etching solutions with each composition are shown in Table 1 to Table 8.

[0036] The relative dielectric constant is that of a solvent (an organic solvent having a hetero atom or an organic acid) + water at 25°C, expressed as a calculated value of an average of the relative dielectric constants of the solvent and water having the particular composition.

[0037] Average of relative dielectric constants = [78.3 x (percentage by weight of water) + (relative dielectric constant of solvent at 25°C) x (percentage by weight of solvent)] / [(percentage by weight of water) + (percentage by weight of solvent)]

HF-H_2O-isopropyl alcohol (PA) etchant

	Solvent	Relative dielectric constant of solvent	HF concentration (%)	Water concentration (%)	Solvent (IPA) concentration (%)	Relative dielectric constant of solvent (IPA)+water (calculated value)	THOX etch rate (A/min.)	TEOS etch rate (A/min.)	BSG etch rate (A/min.)	BPSG etch rate (A/min.)	BSG/THOX selectivity	BPSG/THOX selectivity	BSG/TEOS selectivity	BPSG/TEOS selectivity
Ex. 1	IPA	19.9	5	5	90	23.0	12	11	370	330	31	28	34	30
Ex. 2	IPA	19.9	5	25	70	35.3	55	76	920	1160	17	21	12	15
Ex. 3	IPA	19.9	5	45	50	47.6	97	140	1190	1650	12	17	8.5	12
Ex. 4	IPA	19.9	5	65	30	59.9	140	200	1450	1950	10	14	7.3	9.8
Ex. 5	IPA	19.9	3	3	94	21.7	2	3	120	-	60	-	40	-
Ex. 6	IPA	19.9	10	10	80	26.4	59	82	2200	-	37	-	27	-
Ex. 7	IPA	19.9	15	15	70	30.2	350	230	6500	-	28	-	19	-
Ex. 8	IPA	19.9	20	20	60	34.5	820	1200	12000	-	15	-	10	-
Comp. Ex. 1	(Water)	(78.3)	1	99	0	-	58	93	380	-	6.5	-	4.1	-
Comp. Ex. 2	(Water)	(78.3)	2	98	0	-	120	190	750	-	6.3	-	3.9	-
Comp. Ex. 3	(Water)	(78.3)	3	95	0	-	300	490	1980	-	6.6	-	4.0	-

HF-H_2O-acetic acid etchant

	Solvent	Relative dielectric constant of solvent	HF concentration (%)	Water concentration (%)	Solvent (acetic acid) concentration (%)	Relative dielectric constant of solvent (acetic acid)+ water (calculated value)	THOX etch rate (A/min.)	TEOS etch rate (A/min.)	BSG etch rate (A/min.)	BPSG etch rate (A/min.)	BSG/THOX selectivity	BPSG/THOX selectivity	BSG/TEOS selectivity	BPSG/TEOS selectivity
Ex. 9	Acetic acid	6.15	1	1	98	6.88	10	14	530	750	53	75	38	54
Ex. 10	Acetic acid	6.15	1.25	1.25	97.5	7.06	12	18	1200	940	100	78	67	52
Ex. 11	Acetic acid	6.15	1.5	1.5	97	7.25	17	22	1600	1300	94	76	73	59
Ex. 12	Acetic acid	6.15	2	2	96	7.62	25	33	2600	-	100	-	79	-
Ex. 13	Acetic acid	6.15	2.5	2.5	95	8	32	45	3600	-	110	-	80	-
Ex. 14	Acetic acid	6.15	3	3	94	8.38	40	55	4600	-	120	-	84	-
Ex. 15	Acetic acid	6.15	5	5	90	9.95	97	140	8900	-	92	-	64	-
Ex. 16	Acetic acid	6.15	1.25	5	93.75	9.80	18	23	1600	-	89	-	70	-
Ex. 17	Acetic acid	6.15	1.25	10	88.75	13.5	20	32	1300	-	65	-	41	-
Ex. 18	Acetic acid	6.15	1.25	20	78.75	20.8	32	46	970	-	30	-	21	-
Ex. 19	Acetic acid	6.15	1.25	30	68.75	28.1	39	58	830	-	21	-	14	-
Ex. 20	Acetic acid	6.15	1.25	40	58.75	35.4	40	65	670	-	17	-	10	-
Ex. 21	Acetic acid	6.15	1.25	50	48.75	42.7	43	72	590	-	14	-	8.2	-

HF-H_2O-tetrahydrofurane (THF) etchant

	Solvent	Relative dielectric constant of solvent	HF concentration (%)	Water concentration (%)	Solvent (THF) concentration (%)	Relative dielectric constant of solvent (THF)+water (calculated value)	THOX etch rate (A/min.)	TEOS etch rate (A/min.)	BSG etch rate (A/min.)	BPSG etch rate (A/min.)	BSG/THOX selectivity	BPSG/THOX selectivity	BSG/TEOS selectivity	BPSG/TEOS selectivity
Ex. 22	THF	7.6	5	5	90	11.3	3	4	510	330	170	110	130	83
Ex. 23	THF	7.6	5	25	70	26.2	31	42	690	830	22	27	16	20
Ex. 24	THF	7.6	5	45	50	41.1	64	85	890	1200	14	19	10	14
Ex. 25	THF	7.6	5	65	30	56.0	110	150	1200	1600	11	15	8	11

HF-H_2O-acetone etchant

	Solvent	Relative dielectric constant of solvent	HF concentration (%)	Water concentration (%)	Solvent (acetone) concentration (%)	Relative dielectric constant of solvent (acetone)+water (calculated value)	THOX etch rate (A/min.)	TEOS etch rate (A/min.)	BSG etch rate (A/min.)	BPSG etch rate (A/min.)	BSG/THOX selectivity	BPSG/THOX selectivity	BSG/TEOS selectivity	BPSG/TEOS selectivity
Ex. 26	Acetone	20.7	5	5	90	23.7	3	4	410	250	140	83	100	63
Ex. 27	Acetone	20.7	5	25	70	35.9	24	29	440	520	18	22	15	18
Ex. 28	Acetone	20.7	5	45	50	48.0	49	67	620	760	13	16	9.3	11
Ex. 29	Acetone	20.7	5	65	30	60.1	96	140	960	1300	10	14	6.9	9.3

HF-H_2O-methanol etchant

	Solvent	Relative dielectric constant of solvent	HF concentration (%)	Water concentration (%)	Solvent (methanol) concentration (%)	Relative dielectric constant of solvent (methanol)+water (calculated value)	THOX etch rate (A/min.)	TEOS etch rate (A/min.)	BSG etch rate (A/min.)	BPSG etch rate (A/min.)	BSG/THOX selectivity	BPSG/THOX selectivity	BSG/TEOS selectivity	BPSG/TEOS selectivity
Ex. 30	Methanol	32.6	3	3	94	34.0	0.5	7	44	73	88	150	6.3	10
Ex. 31	Methanol	32.6	5	5	90	35.0	3	9	170	230	57	77	19	26
Ex. 32	Methanol	32.6	10	10	80	39.9	22	43	730	410	33	19	17	9.5

HF-H_2O-ethanol etchant

	Solvent	Relative dielectric constant of solvent	HF concentration (%)	Water concentration (%)	Solvent (ethanol) concentration (%)	Relative dielectric constant of solvent (ethanol)+ water (calculated value)	THOX etch rate (A/min.)	TEOS etch rate (A/min.)	BSG etch rate (A/min.)	BPSG etch rate (A/min.)	BSG/THOX selectivity	BPSG/THOX selectivity	BSG/TEOS selectivity	BPSG/TEOS selectivity
Ex. 33	Ethanol	24.6	5	5	90	27.4	7	9	250	210	36	30	28	23

HF-NH_4F-H_2O etchant (Comparative Examples)

	Solvent	Relative dielectric constant of solvent	HF concentration (%)	NH_4F concentration (%)	Solvent (water) concentration (%)	THOX etch rate (A/min.)	TEOS etch rate (A/min.)	BSG etch rate (A/min.)	BPSG etch rate (A/min.)	BSG/THOX selectivity	BPSG/THOX selectivity	BSG/TEOS selectivity	BPSG/TEOS selectivity
Comp. Ex. 4	(Water)	(78.3)	1	39.1	59.9	170	230	110	-	0.6	-	0.5	-
Comp. Ex. 5	(Water)	(78.3)	2	2	96	280	480	620	-	2.2	-	1.3	-
Comp. Ex. 6	(Water)	(78.3)	2	5	93	320	640	440	-	1.4	-	0.7	-
Comp. Ex. 7	(Water)	(78.3)	2	10	88	400	700	350	-	0.9	-	0.5	-
Comp. Ex. 8	(Water)	(78.3)	2	20	78	420	720	270	-	0.6	-	0.4	-
Comp. Ex. 9	(Water)	(78.3)	2	30	68	390	610	230	-	0.6	-	0.4	-
Comp. Ex. 10	(Water)	(78.3)	2	38.7	59.3	300	450	200	-	0.7	-	0.4	-

HF-H_2O-acid-added etchant

	Added acid	pKa of acid	HF concentration (%)	Water concentration (%)	Acid concentration (%)	THOX etch rate (A/min.)	TEOS etch rate (A/min.)	BSG etch rate (A/min.)	BPSG etch rate (A/min.)	BSG/THOX selectivity	BPSG/THOX selectivity	BSG/TEOS selectivity	BPSG/TEOS selectivity
Ex. 34	HCl	-8	0.1	64	35.9	17	32	440	-	26	-	14	-
Ex. 35	HCl	-8	0.25	63.9	35.8	53	89	1200	-	23	-	13	-
Ex. 36	HCl	-8	0.5	63.9	35.6	120	200	2500	-	21	-	13	-
Ex. 37	HCl	-8	0.75	63.8	35.5	180	300	4300	-	24	-	14	-
Ex. 38	HCl	-8	1	63.7	35.3	240	380	4500	-	19	-	12	-
Ex. 39	HNO3	-1.8	1	30.4	68.6	240	340	5300	-	22	-	16	-
Comp. Ex. 11	H3PO4	2.15	1	15.7	83.3	120	170	850	-	8.7	-	5.9	-
		(pKa1) 7.20 (pKa2) 12.4 (pKa3)								7.1	-	5	-

Claims

1. An etching solution comprising hydrofluoric acid, wherein a ratio of an etch rate of a boron silicate glass film (BSG) or boron phosphosilicate glass / an etch rate of a thermal oxide film (THOX) at 25°C is 10 or higher.

2. The etching solution according to claim 1, wherein a solvent in the etching solution has a relative dielectric constant of 61 or lower.

3. The etching solution according to claim 1, the solution containing at least one member selected from the group consisting of an organic acid and an organic solvent having a hetero atom.

4. The etching solution according to claim 1, the solution containing (i) water and (ii) at least one member selected from the group consisting of an organic acid and an organic solvent having a hetero atom, the water being contained in a concentration of 70% by weight or lower.

5. The etching solution according to claim 1, wherein the weight ratio of HF : isopropyl alcohol : water is 0.1-50% by weight : 30-99% by weight : 0-70% by weight.

6. The etching solution according to claim 1, wherein the weight ratio of HF : acetic acid : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.

7. The etching solution according to claim 1, wherein the weight ratio of HF : tetrahydrofuran : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.

8. The etching solution according to claim 1, wherein the weight ratio of HF : acetone : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.

9. The etching solution according to claim 1, wherein the weight ratio of HF : methanol : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.

10. The etching solution according to claim 1, wherein the weight ratio of HF : ethanol : water is 0.1-50% by weight : 30-99.9% by weight : 0-70% by weight.

11. The etching solution according to claim 1, the solution comprising an inorganic acid.

12. The etching solution according to claim 11, wherein the inorganic acid has a pKa value at 25°C of 2 or lower.

13. The etching solution according to claim 11, wherein the weight ratio of HF : HCl : water is 0.01-50% by weight : 1-36% by weight : 0-99% by weight.

14. The etching solution according to claim 11, wherein the weight ratio of HF : HNO_3 : water is 0.01-50% by weight : 1-70% by weight : 0-99% by weight.

15. A method for producing an etched article by etching an article to be etched with the etching solution as defined in any of claims 1-14.

16. An etched article which is obtainable by the method of claim 15.

INTERNATIONAL SEARCH REPORT

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PCT/JP99/06502

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H01L 21/306, 21/308,
Int.Cl[7] C09K 13/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Jitsuyo Shinan Toroku Koho 1996-2000
Kokai Jitsuyo Shinan Koho 1971-2000 Toroku Jitsuyo Shinan Koho 1994-2000

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP, 52-56869, A (Tokyo Shibaura Denki K.K.), 10 May, 1977 (10.05.77), Table 1; Fig. 3 Table 1; Fig. 3 (Family: none)	1-5,9,10,15,16 12,14
Y	JP, 58-204540, A (Matsushita Electric Works, Ltd.), 29 November, 1983 (29.11.83) (Family: none) Example 1	12,14
A	EP, 669646, A1 (Texas Instruments Inc.), 30 August, 1995 (30.08.95), Figs. 1 to 3 & JP, 7-240474, A & TW, 288168, A	1-16
PA	EP, 887323, A1 (International Business Machines Corp.), 30 December, 1998 (30.12.98), Claims & JP, 11-60275, A & CN, 1203205, A	1-16
PA	JP, 11-74249, A (Samsung Electron Co., Ltd.), 16 March, 1999 (16.03.99),	1-16

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
09 February, 2000 (09.02.00)	22 February, 2000 (22.02.00)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/06502

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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